



ALIVE!

BUTYRATE AND THE BOWEL, PT 1

MODERN MAN HAS A problem with his colon. Yep, whether its diverticulosis, diverticulitis, ulcerative colitis, Crohn's disease, irritable bowel syndrome, inflammatory bowel disease, colon cancer, diarrhea, constipation, pain upon defecation, abdominal pain, straining, bloating, incomplete evacuation, blood in stools, sense of urgency, and so on, we've got problems. No doubt about it, our society is becoming increasingly aware of this important part of our anatomy and we probably all have a story to tell.

Housed within the large intestine are trillions of microbes that are referred to collectively as the microbiome, a community of various strains of bacteria, fungi, and yeasts that live and thrive in the dark, dank, recesses of our digestive tract. In their own fashion, microbes respire and digest to survive, producing byproducts that science is discovering have a potentially dramatic impact on how we feel, what we look like, our physical condition, how much energy we have, how occluded our arteries are, how resistant we are to insulin, and of course the vigor and health of its host organ, the colon.

The strains of microbes that flourish in our personal microbiome are in part determined by what you feed them. Certain strains of bacteria ferment carbohydrates that have been thus far indigestible in the digestive system.

As the bacteria break these indigestible carbohydrates down, byproducts are released. Butyrate is one of these byproducts. Butyrate has nicknames by which it is also called, butyric acid and butanoic acid, but we will refer to it as butyrate. Butyrate is a short-chain fatty acid. There are also long-chain and medium-chain fatty acids. These terms are simply referring to how many carbon atoms are attached to each other, literally how long an individual molecule is. Butyrate is short, with only four carbons side by side. It is one of the acids produced by resident bacteria in the large intestine. Butyrate sets itself apart from all the rest by its odor, which researchers have described as extremely pungent, much like bad smelly socks. Its contribution to our health also distinguishes it and has made it the object of much attention.

The bacteria that give birth to butyrate flourish when supplied with indigestible carbohydrates. More recognizable terms would include fiber, inulin, and resistance starch. Butyrate is one of the byproducts of bacteria breaking down these indigestible carbohydrates. Once it is produced and released into the colon, butyrate is readily absorbed by the human cells that make up the lining of the colon. It is their preferred energy source. What gas is to a car, what glucose is to the brain, what sunshine is to solar panels, butyrate is to the cells that make up the surface of the colon.

It has been suggested that the failure of butyrate to be oxidized or used for energy in ulcerative colitis is an expression of "energy deficiency disease of the colonic mucosa."¹

Butyrate regulates the production of new, fresh colon cells and the destruction of old or unhealthy colon cells. This is a process that is literally taking place all the time. The epithelial cells that line the surface of the gut have a rough life and last only five days, meaning that a four-day-old cell, lining the

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large intestine's wall, is old and on its way out. The average age of the rest of the colonic cells in the main body of the gut is approximately 16 years. The surface of the colon is one of the fastest replicating tissues in the body. Butyrate provides energy and supports proliferation of colonocytes. Butyrate has been found to activate cell proliferation and maturing of healthy normal cells while inducing early apoptosis, or cell death, in cancer cells. In other words, butyrate helps healthy cells to grow and facilitates the destruction of unhealthy cells.

COLON CANCER

Butyrate, as we mentioned, is a fatty acid. Its presence contributes to a lower pH in the colon, making it slightly acidic. This acidic pH in turn provides a supportive environment in which butyrate-producing bacteria flourish. Simultaneously, a slightly acidic large intestine is also an environment that discourages colon cancer development and growth. Dietary fiber and its breakdown product, butyrate, have been found protective against colon cancer for a number of reasons.² "Butyrate is recognized for its potential to act on secondary chemoprevention, by slowing growth and activating apoptosis (programmed cell death) in colon cancer cells."³

DIABETES / INSULIN SENSITIVITY

Mice received a supplement of sodium butyrate and were fed a high fat diet, 58% of the calories were from fat. Amazingly, even though the mice were fed a very high fat diet, supplementation of butyrate was found to prevent the development of insulin resistance and obesity. Fasting blood glucose, fasting insulin, and insulin tolerance were all preserved in the treated mice. Body fat content was maintained at 10% without a reduction in food intake. Calorie burning and fatty acid oxidation (fat being combusted as a

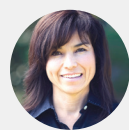
fuel source) were enhanced. An increase in mitochondrial function (energy production) and biogenesis was observed in skeletal muscle and brown fat. The type I fiber was enriched in skeletal muscle. In the obese mice, supplementation of butyrate led to an increase in insulin sensitivity and a reduction in body fat.⁴

IMMUNITY

Short-chain fatty acids influence gut immune response, suppressing colonic inflammation. Butyrate works as an anti-inflammatory agent by inhibiting pro-inflammatory substances in the lining of the colon. It improves gut defense systems while keeping the immune system from overresponding or overreacting. A Japanese study conducted with mice demonstrated that butyrate played a role in reducing inflammation by stimulating the production of regulatory T immune cells. These immune cells hinder excessive inflammation and autoimmune disorders. When mice with colitis received butyrate supplementation, their levels of T cells increased and their symptoms improved. Dr. Hiroshi Ohno, lead researcher stated, "Therefore these findings could be applicable for the prevention and treatment of inflammatory bowel disease (IBD), allergy and autoimmune disease."⁵

As a community, the microbiome is extremely influential in the body and we will continue to explore its significance next month. 🌱

1. W. Roediger, "The Colonic Epithelium in Ulcerative Colitis: An Energy-Deficiency Disease?," *The Lancet*, <http://www.sciencedirect.com/science/article/pii/S0140673680919340>.
2. Canani, Roberto Berni, et al., "Potential Beneficial Effects of Butyrate in Intestinal and Extraintestinal Diseases," *World Journal of Gastroenterology*, March 28, 2011, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3070119>.
3. Ibid.
4. Z. Gao, J. Yin, J. Zhang, R.E. Ward, R.J. Martin, M. Lefevre, W.T. Cefalu, J. Ye, "Butyrate Improves Insulin Sensitivity and Increases Energy Expenditure in Mice," *Diabetes*, July 2009, <http://diabetes.diabetesjournals.org/content/58/7/1509.long>.
5. RIKEN, "Fatty acid produced by gut bacteria boosts the immune system," *ScienceDaily*, November 13, 2013, www.sciencedaily.com/releases/2013/11/131113132202.htm.



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